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ARGON.

THE plain facts concerning argon are these: For some time past Lord Rayleigh has been engaged on refined work involving the weighing of various gases. Last year he found that the nitrogen obtained from the air is a little heavier than that made from definite chemical compounds. This led him to further experiments and, at the same

time, Professor W. Ramsay, of University College, London, also undertook experiments with the object of explaining, if possible, the discrepancy. The general method of work consisted in passing air, first through substances that have the power to remove those constituents that are present in small quantities, such as water vapor, carbonic-acid gas, etc., then through a heated tube containing copper. The oxygen of the air unites with the heated copper, and what has hitherto been regarded as nitrogen remains uncombined. This 'atmospheric nitrogen' was subsequently treated in three different ways for the purpose of removing the nitrogen from it.

(1) It was drawn through clay pipes in the hope that, if the gas is a mixture, one of the constituents would pass through the porous material more easily than the other, and at least a partial separation be thus effected. While something was accomplished in this way, the experiment was on the whole unsatisfactory.

(2) The 'atmospheric nitrogen' was mixed with oxygen in a vessel containing caustic alkali, and electric sparks were passed through the mixture. Under these circumstances the oxygen united with nitrogen and formed a compound which is soluble in alkali. After no further absorption of nitrogen could be effected by sparking, any unchanged oxygen present was removed, and there was then found a residue

of gas which was certainly not oxygen nor nitrogen. This proved to be the substance about which the world is now talking.

In this connection it is of great interest to note that Cavendish, in 1785, probably had this same substance before him free from nitrogen. He performed the experiment above described, and noticed the residue, and says in regard to it: "We may safely conclude that it is not more than $\frac{1}{150}$ of the whole." This is very nearly the truth as regards the relative amount of argon in the air.

(3) The most satisfactory method for obtaining the gas on the large scale consists in passing 'atmosphere nitrogen' over highly-heated magnesium, which has the power of uniting with nitrogen, while the newly-discovered gas has not this power. But, even by this method, the preparation is very slow, and, up to the present, the gas cannot easily be obtained in large quantity.

The new substance is heavier than nitrogen. The density of hydrogen being taken as unity, that of nitrogen is 14, of oxygen 16, and of argon 19.7.

Perhaps the most remarkable property of argon is its inertness. It has not been possible thus far to get it to combine with any other substance, so that anything more than a general comparison with known substances is out of the question. It owes its name to its inertness, argon being derived from two Greek words signifying 'no work.'

A determination of the ratio of the specific heat of argon at constant pressure to that at constant volume was determined by means of observations on the velocity of sound in the gas, and the ratio was found to be 1.66. This is of much importance as showing that the particles of which the gas is made up act as individuals. If this conclusion is correct, it follows further that argon must be either a single element or a mixture of elements, and that, if it is a single element, its atomic weight must be

nearly 40, as its density is 19.7 and its atom is identical with its molecule.

Professor Crookes has studied the spectra of argon and, in an article giving his results in detail, he says: "I have found no other spectrum-giving gas or vapour yield spectra at all like those of argon." * * * "As far, therefore, as spectrum work can decide, the verdict must, I think, be that Lord Rayleigh and Professor Ramsay have added one, if not two members to the family of elementary bodies."

Finally, Professor Olszewski, of Cracow, the well-known authority on the liquefaction of gases has succeeded in both liquefying and solidifying argon. It was found to boil at 186.9° C., and to solidify at 189.6° C., forming a mass resembling ice.

To quote from Professor Ramsay's article read before the Royal Society: "There is evidence both for and against the hypothesis that argon is a mixture: *For*, owing to Mr. Crookes' observations of the dual character of its spectrum; *against*, because of Professor Olszewski's statement that it has a definite melting point, a definite boiling point, and a definite critical temperature and pressure; and because, on compressing the gas in presence of its liquid, pressure remains sensibly constant until all gas has condensed to liquid."

The above is a brief account of all that is known about argon, and it would evidently be premature to indulge in speculation regarding its position in the system. It may as well be said at once that, if it is an element or a mixture of elements, it will apparently be difficult to find a place for it on Mendeléeff's table. It will be well to await developments before worrying on this account. If the time should ever come when Mendeléeff's table has to be given up, something better will take its place.

The suggestion has been made repeatedly that argon is perhaps an allotropic form of nitrogen. The strongest argument against

this view is the established fact that the gas conducts itself as if made up of individual particles, while any allotropic form of nitrogen, which is heavier than this, must, according to all that we know of such matters, consist of more complex molecules than nitrogen itself.

IRA REMSEN.

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*THE FUNDAMENTAL DIFFERENCE BETWEEN PLANTS AND ANIMALS**

To the advanced student, as to the investigator, the question of a definite and accurate distinction by which all true plants can be distinguished from all true animals, is a question of minor interest. To the beginning student the question, on the contrary, is a pressing one for which the answer is urgently claimed. Thus I am led to believe that the definition given below, though it cannot add anything essential to the conceptions of investigators, will nevertheless prove valuable to teachers of biology.

The usual method of drawing a contrast between the animal and vegetable kingdoms, for the purpose of establishing some sort of definition of the two in students' minds, is to leave out of consideration the lower forms, and to take into consideration only the higher forms, on the one side plants with chlorophyll, on the other the multicellular animals or so-called Metazoa. It is then easy to establish a difference in the physiological nutritive processes, emphasizing the synthetic processes, particularly the power of bringing free nitrogen into combinations on the part of plants and the absence of the synthetic process among animals. It is much to be regretted that this method of defining animals and plants has been and still is very widely used, for it leads to inevitable perplexity, because the next thing almost which the student must

learn is that the distinction does not hold true. On the one hand, he learns that among plants there are many forms without chlorophyll and that these cannot bring nitrogen into combination and must secure proteid food. On the other hand, he learns that among animals numerous synthetic processes occur, and if he takes up the study of medical physiology he learns many instances of synthetic chemical work on the part of the mammalian body. Dr. F. Pfaff has kindly indicated to me two striking instances of synthesis in the mammalian body, first, the formation of glycuronic acid after the administration of camphor or turpentine, and second, the formation of hippuric acid after the administration of benzoine.

Another distinction often drawn between animals and plants is that of the presence or absence respectively of internal digestive organs. But this again soon leaves the student in the lurch, for the first amœbea he examines knocks that distinction out of the ring.

We may, however, I think, rightly define the two primary divisions of the living world thus:

Animals are organisms which take part of their food in the form of concrete particles, which are lodged in the cell protoplasm by the activity of the protoplasm itself.

Plants are organisms which obtain all their food in either the liquid or gaseous form by osmosis (diffusion).

There are certain facts which appear to invalidate these definitions. The most important of such facts, so far as known to me, is afforded by the Myxomycetes, which, as well known, while in the plasmodium stage of their life-cycle, take solid particles of food very much after Amœba-fashion. Through the kindness of Professors W. G. Farlow and G. L. Goodale, I have learned that there are no other plants which at the present time are known to take solid food

* Read before the American Society of Morphologists at Baltimore, December, 1894.

at any stage. I understand also that botanists are by no means agreed to accept the Myxomycetes as veritable plants. One cannot but ask, Have we not here organisms which connect the two kingdoms? Certainly, in using the above definitions in teaching, it will always be easy to specify the one exception offered by the Myxomycetes and still leave a clear and available conception in the student's mind.

Other facts, which stand in the way of strictly upholding the two definitions, are encountered among animal parasites. For example, a tape-worm in the intestine does not apparently take up any solid food, but is nourished by absorption through the surface of its body of food material in solution. But in these cases we have evidently secondary modifications due to the parasitic life, and in the near relatives of the tape-worms, the trematods and planarians, solid food is taken up. It is to be remarked, too, that it is possible, though perhaps not probable, that even tape-worms will be found on more careful study to take up solid food.

The extent to which it has now been demonstrated that animals take up food in the form of discrete solid particles is not realized generally. The process has been observed with varying degrees of accuracy in the entodermal cells of the digestive tract of hydroids, ctenophores, planarians, trematods, annelids, crustacea, insects, amphibia and mammals, and probably in other forms, which have not come to my notice in this regard. There is here offered a rare opportunity for a valuable research, by making a comparative study of the absorption of solid food. That the protozoa take up particles by means of their pseudopodia is certainly one of the most familiar and most be-taught facts of elementary biology.

I believe that we can also safely teach that the absorption of solid particles of food is to be considered one of the most essential factors in determining the evolution of the

animal kingdom. The plant receives its food passively by absorption, and the evolution of the plant world has been dominated by the tendency to increase the external surfaces—to make leaves and roots. The animal, on the contrary, has to obtain at least the solid part of its food by its own active exertions, and to the effects—through natural selection—of the active struggle to secure food we may, I think, safely attribute a large part of the evolution of locomotor nervous and sensory systems of animals. That it has been the only factor cannot be asserted of course for a moment, but it is presumably not going too far in speculative conclusions to look upon it as the most important single factor. An equally important rôle must be attributed to the taking of solid food in connection with the evolution of digestive organs, which are cavities which hold food material until it is absorbed by the cellular walls of the cavities. Indeed, we may expect to find that the entodermal cavity had originally no digestive function whatsoever, but was merely a receptacle to retain the food while the surrounding entodermal cells swallowed it at leisure.

With these speculations I will close, adding only that the speculations have in themselves little value, their only value being to suggest lines of research, which appear promising. The sober naturalist avoids the infernal dipsomania for sheer speculation, and in this article I have already yielded sufficiently to the temptation.

CHARLES S. MINOT.

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*THE BEST ORDER OF TOPICS IN A TWO-YEARS' COURSE OF ANATOMY IN A MEDICAL SCHOOL.**

TEACHERS of anatomy differ so widely in their views as to the most useful arrangement of the various branches of the subject

* A paper read at the annual meeting of the Association of American Anatomists, in New York, 28th December, 1894.

that it is desirable to clear the field as far as possible at the very beginning of our discussion by the elimination of those points upon which there is substantial agreement. I assume that there is no diversity of opinion on the places which should be occupied by histology and topography. It is to my mind perfectly manifest that the student cannot profitably or comfortably receive instruction in gross anatomy until he has learned the elements of histology: has become familiar with the characters of the various textures which make up the parts and organs of the body, and to which, of necessity, references are constantly made in macroscopic anatomy. By identically the same method of reasoning the conclusion is reached that topography should be taken up latest of all; for it cannot be in a high degree useful to the pupil to work at the relations in space which different organs sustain to each other, until he has acquainted himself with the facts of their shape, size and consistency. To attempt descriptive anatomy without histological knowledge is comparable to studying architectural structures in perfect ignorance of the qualities of building materials, such as stone, brick, wood, iron and mortar; and to undertake regional, before being well grounded in systematic, anatomy is about as possible as reading sentences before acquiring words, or studying the relations of any other things without knowing something about the things themselves. Besides, there is a marked advantage in the incidental, but searching, review of every preceding portion of gross anatomy involved in the pursuit of topographical; and all teachers recognize the vast importance of such repetitions for the student, even if they do not admit that they themselves retain their familiarity with this science of innumerable details only by virtue of incessant review in one way or another.

There is certainly room for difference of

opinion concerning the most advantageous marshaling of the remainder of the topics with which we have to deal; but our decision should probably be in largest measure determined by the circumstances in which it is necessary to pursue the study. If the pupil is to devote himself to anatomy only, no great objection is to be raised to the order of subjects adopted in the text-books in most common use—the order which, I think, the majority of teachers employ—beginning with osteology, and following in regular succession with arthrology, myology, angiology, neurology and splanchnology. Much can be said in support of this arrangement. The knowledge of vessels, their origins and terminations, can be of little avail, if there is not a precedent acquaintance with the muscles and other structures which they flush with nourishing blood, or drain of unneeded and effete material; and so, before undertaking angiology, we need especially to study muscles, which constitute so large a part of the human bulk outside of the great cavities, and in which are found so considerable a proportion of the tubes of supply and waste with which we have to deal in the practice of medicine and surgery. The nerves, too, cannot be studied to advantage without antecedent familiarity with the muscles, which are the objective point of their motorial function. In their turn, also, the active organs of locomotion are never learned unless there is a well-laid foundation of skeletal knowledge, upon which to build them; for, in absence of this basis, they are but impotent, flabby, almost shapeless masses of flesh, but little amenable to description, and quite elusive of comprehension. Arthrology is plainly out of the question without osteology, which should immediately precede it. The study of the viscera and organs of special sense concludes the series.

This arrangement is not altogether free from objections. For instance, even after

one knows the skeleton and the muscles clothing it, he finds in his study of the arteries much that he cannot fully comprehend from lack of acquaintance with the viscera. But no method can be absolutely perfect: one needs to know all of his anatomy—the whole of everything—in order to understand any one organ perfectly. The problem, therefore, for us, as teachers, is to discover that plan which reduces to the minimum this necessity of knowing a good deal of every department of our great science before entering upon the study of any one of them; and particularly the scheme which makes this need least conspicuous in the earlier portion of the course, when everything is new; for, since the growth of one's anatomical knowledge makes further acquisition in the same line progressively easier day by day, because he is all the time getting nearer to the goal of knowledge of the whole, the last part of the course is naturally that in which there is the least occasion for such help as can be derived from a wise order of topics. After all, however, the arrangement in question is useful, perhaps as good as any other, provided that there is an observance of the condition which I have attached to my commendation of it; but without this provision it seems to me to be clumsy, obstructive, wasteful and irrational.

The condition is that the student is attempting nothing else than anatomy. Practically this is a state of affairs which never obtains in the schools, and is not in the least likely to occur; always physiology is studied synchronously, and usually, also, general chemistry—the latter a branch with no more claim to be regarded as a legitimate topic of medical study than have botany and zoölogy, and, in all fairness to student, school and community, should be required as a preliminary to the medical course. We may confidently count upon finding the first-year student occupied equally with

physiology and anatomy. Now, it is so obvious as to require no argument that the action of an organ can never be studied with complete satisfaction until its structure is well understood. Consequently, the anatomy of each part should be learned before its function is presented, in order that the pupil may work intelligently and be spared much difficult and unproductive effort. If the professor of anatomy does not aid him in this matter, the physiologist is driven to perform the task, although it is outside of the proper sphere of his work, and involves the expenditure of much time which he needs for affairs in his own peculiar field. The physiology which we most require is a knowledge of the offices of the viscera, and the teachers of this branch necessarily devote the greater part of their instruction to the consideration of the action of these organs, which, according to the conventional order of topics in the anatomical course, are not touched until all other portions of systematic anatomy have been disposed of. As a result of this, in the early part of the course the anatomist is teaching a vast number of things which are of the smallest possible help to the student of physiology; and, in almost the last part, he goes over ground which has been traversed long before by a suffering colleague, who has been forced into this unwilling usurpation by the unhappy arrangement of the anatomical schedule. In other words, a large and important (to my thinking, the most important) section of anatomy is not taught by the professor of this branch at a period when it is most urgently required by the student, and is presented by him long after it has been already learned.

Surely this state of affairs is, to say the best of it, deplorable, and should not be permitted to continue, if it can be abolished without injustice to the interests of the science to which we dedicate so much of our lives. Each one of us should bear con-

stantly in mind that he is not merely an instructor in a special branch, but is, besides this, a member of a faculty, the purpose of which is to give to medical students the most complete, well-rounded, professional education possible with the available means. On the old lines, which schools have followed far too long, and which are not yet abandoned by all institutions, every professor discoursed to the entire class—a higgledy-piggledy arrangement (perhaps derangement would be the more appropriate designation for so lunatic a scheme) which would not be tolerated for a week in a common school of the lowest grade. Gradually faculties are becoming converted to the idea that a grading of the course is essential to the best results; and those branches which are natural stepping stones to others are completed before advanced studies are undertaken. But much still remains to be done before the most useful system is formulated, and the part of this work which most concerns us is the proper adjustment of our topics to the needs of our colleagues who teach physiology. The plan which I am about to propose is designed especially to attain this end, and will be seen, I trust, to be the most advantageous in other respects, also. It is devised in the spirit which should actuate every individual in a body which is formed to accomplish a given purpose; each one is bound not simply to do these things which will make his department a success, but to do them in such a way as to promote the interests of every other chair. There should be perfect coördination in teaching—the faculty should work always as a ‘team,’ if a popular expression may be used. In no other way can the highest results be achieved.

In the first place I would have the anatomist ascertain the exact order of topics in the course of his physiological colleague. Let us suppose that the latter purposes, after a little time spent in necessary preliminary

considerations, to conduct his class into the realm of the circulation. The anatomist will precede him by a day or two with the study of the organs by means of which circulation is performed. The structure of the heart will be presented with as much of detail as is requisite for the ready comprehension of its action, and this will be followed by the physiological anatomy of the blood vessels: the materials of which they are composed, the arrangement of these, and the variations in their proportions in the large, medium, and small vessels respectively; the physical qualities of the walls; the style of division and union: how the great arterial trunks branch and divide until the most diminutive twigs terminate in capillaries, and how the venous radicles begin in the midst of the tissues and by successive and innumerable conjunctions form larger tubes until the great tap-roots of the system are reached; in short, all those points which aid in the understanding of the function of these organs. He makes no attempt at this stage of the course to present the systematic anatomy of the arteries and veins; perhaps not a single vessel of the great multitude is called by name, except those which, being attached to the heart, must be specifically designated in order to make the description of that organ intelligible. He does not undertake to describe the relations in space which the heart and principal vessels sustain to the parts by which they are surrounded; for he knows that these relations might be very different without essential modification of their action, and that therefore they need not be introduced at this period of the curriculum. Thus, the students are well equipped to receive instruction on the circulation from the professor of physiology, and the latter is free to devote his energies entirely to the work which alone he should be expected to undertake.

This example is no more striking than any other; but it serves well to illustrate

on the physiological side the benefits coming from the adoption of the order which I advocate. In this manner the course proceeds; and no portion of the field is entered upon by the physiologist which has not been explored and surveyed as far as structure is concerned by the anatomist in company with the same set of pupils. After the study of the viscera, including the cerebro-spinal centres and the organs of special sense, comes the consideration of the remaining branches of systematic anatomy, beginning with the skeleton and proceeding in the conventional order.

That much advantage accrues to the class in physiology by the execution of this plan seems to me to be perfectly clear. That any anatomical sacrifice is made by it I do not believe. On the contrary, a distinct benefit is gained even in anatomy; for the learning of the function of an organ immediately after the study of its structure serves to emphasize and deepen the impression made by the earlier lesson, and quickens with a living interest what otherwise might remain in the mind only as dry and arbitrary fact, if, indeed, it did not lapse altogether from memory because of its lack of significance.

Incidentally, too, there results great profit of a practical kind, which is lost in following the common order. Students usually know less about visceral anatomy than about any other section of the science. This comparative ignorance depends upon three causes. The first is the fact that the ordinary text-books are far less accurate in the description of the viscera than in that of other parts—a statement which it is unnecessary to substantiate in this learned presence. Second, the study of the viscera is much more difficult than that of other parts. In their best estate they present appearances which are liable to be misleading even to the most careful and experienced observers, as witness the conspicuous errors

which for generations passed muster regarding the form of the liver and the position of the stomach—points still misstated in some of the text-books of the day. But another obstacle is often more serious than this. If the organs are fresh, much that is valuable can be learned from them; but when they are the seat of advanced putrefactive changes, as often happens when the muscles and associated parts are still useful for somewhat prolonged examination, they must be removed speedily, without affording the slightest opportunity for careful observation. Third, as the subject of the viscera is usually placed last in the study of systematic anatomy, it is more likely than anything else to be slighted. We all doubtless know from observation, and some of us probably from personal experience, that the enthusiasm of a novice in a study rarely is sustained to the end. In fact, it may be said without incurring the imputation of exaggeration that a large majority of students in any class flag very noticeably towards the close of the term, however eagerly they may have started out. Unquestionably most medical men, young or old, know more about osteology than about any other branch of anatomy. The reasons of this are not far to seek. The skeleton is less perishable than the soft parts and hence the opportunities for the study of it are vastly greater; and, what seems to me to be of quite as deep significance, it is generally the first branch of our science which the student attacks. It is his memorable, first step inside the mighty and mysterious domain of medicine, and, consequently, every detail makes a powerful impression on his plastic mind. Although he sees that his book contains much besides osteology, this is the first and, by inference, the most important of its contents. The common people sometimes speak of a skeleton as an anatomy; and the young student almost deludes himself with the

notion that he knows the bulk of anatomy, when he has acquired a very general conception of the bones. Of course, his ideas are silly and childish, and have to be corrected; but we must take human nature as we find it, and, if possible, turn its very weaknesses into useful channels. Now, without having the smallest disposition to belittle the advantage of an accurate knowledge of the skeleton, it has long been a conviction with me that visceral anatomy should be ranked first in the list of topics, considered from the purely utilitarian point of view: that the subject of which our students generally know least is precisely that of which they ought to know most. They come to us in order to be equipped as practitioners. Whatever may be their callow aspirations, however much they may be dazzled and charmed by the brilliant performances of surgery, we and all of our colleagues know that the enormous majority of them must be general practitioners, doing almost no surgical operations, except the strictly minor; having a great many obstetric cases; seeing a multitude of sick infants, a good many ailing women, and not a few acutely ill adults of both sexes. What is the greatest anatomical need of such men? Is it not undeniable that, for one case demanding in them a knowledge of bones, muscles, blood vessels or nerves, they have at least a score in which they must know something definitely about the structure of lungs, heart, stomach, bowels, liver, kidneys, uterus or brain? If, then, visceral anatomy far surpasses all other portions of the field in importance to the enormous majority of practitioners of the healing art, it should be placed first chronologically in the course of systematic anatomy, so that it shall be taught at the time when the learner's mind is most eagerly receptive and most faithfully retentive—provided, of course, that this assignment of position does not conflict with the rights of other things.

Unless my argument has utterly miscarried, it is established that the proposed order not only does not sacrifice anything on the physiological side, but is even of conspicuous advantage to it; and I have been unable to discover any way in which it can affect unfavorably the welfare of any department whatsoever. There is no occasion for anxiety lest the postponement of osteology will result in its being ignored or slighted. The facilities for its study are so comparatively abundant, the conventional conception of its importance is so deeply rooted, and the natural and inevitable attraction which it exercises on the student is so strong as to insure the bestowal upon it of a sufficient share of his attention.*

With me the order advocated is not merely a theory: it is a long accomplished fact. For about fifteen years I have had the plan in practical operation, and have not yet observed a single thing which has caused me to regret the change from the ancient system. It appears to me now, as in the beginning, to be the most rational, economical, facile, attractive and useful succession of topics. During this prolonged trial of the order I have had as fellow-members of the Bowdoin faculty in the chair of physiology three gentlemen, of whom two, Drs. B. G. Wilder and C. D. Smith, are members of this Association, and can testify as to the usefulness of the plan.

* It would be foolish to disparage the cultivation of any portion of the field of human anatomy; the more thoroughly the physician knows every part of it, the better equipped will he be as a practitioner. Vastly more blunders than are ever recognized depend upon ignorance of easily known facts of structure. But the tremendous insistence upon the supreme value of osteology, which characterizes the method of some teachers of anatomy, seems to me to demonstrate a lack of sense of proportion, which, while easily enough accounted for by the student of medical history, who appreciates also the dominating (sometimes almost domineering) influence of habit and suggestion upon the mind, is none the less peculiarly unfortunate in its effect.

The third, Dr. Henry Hastings Hunt, has within a month ceased from his labors, and been borne to his honored grave; but I feel justified in giving his testimony emphatically in its favor.

My plan, slightly detailed, is as follows: Beginning with some explanations of a general character, and the definition of certain terms which are so technical that the novice cannot be expected to know them, I give the names, both English and Latin, and the limits of extension of all of the superficial parts; for I have learned that it is not safe to count on anybody's knowing what an anatomist or surgeon means by various terms applied to parts which are visible without dissection, and have vernacular appellations. Histology is then presented in an elementary way, and the student is taught the essential truths about the simple tissues. The different kinds of membranes are discussed, and the structure of glands in general is naturally given the next place. The student is now fairly equipped for the study of the viscera, and these are taken up in whatever order the physiologist of the institution prefers. In one important particular my course at this period differs from visceral anatomy as presented in most of our books; the brain and spinal cord, the noblest and most interesting of all entrails, are included in the company of the viscera, and not, as ordinarily in the text-books, with the nerves. After this come in regular, conventional style the bones, ligaments, muscles, arteries, veins, lymphatics and nerves; and, last of all, topographical, or, as I prefer to call it, relational anatomy.

In this scheme no separate place is assigned to embryology, a subject usually treated in obstetrical and physiological works, as well as in anatomical. By agreement with my colleague in physiology, its systematic presentation is made by him; but all through my course the facts of development are introduced, not only to in-

form the student upon points of practical moment, but also to illustrate and enforce many features of adult structure.

At the end of his first year in the school the student is required to pass a satisfactory examination in histology, splanchnology, and osteology, and he is not permitted to enter upon second-year studies until he has so passed. At the end of his second year he is examined on the remainder of systematic and all of relational anatomy, failure excluding him from his third year.

It will be observed that I have confined my remarks strictly to the subject announced, and have refrained from discussing the relative merits of various methods of imparting instruction, as by lectures, recitations, demonstrations, and so forth. I wish it to be understood, however, that, if any expression of mine has seemed to imply that the old-time method of teaching by lectures holds the first place in my esteem, I have unwittingly done an injustice to a cherished conviction; for the lecture system, as an exclusive, or even principal, method of instruction, has long seemed to me to be the worst which has been devised.

FREDERIC HENRY GERRISH.

BOWDOIN COLLEGE.

CURRENT NOTES ON PHYSIOGRAPHY (IV).
MERRIAM ON THE DISTRIBUTION OF ANIMALS
AND PLANTS.

A STUDY that is admirable, alike in its quality and its results, has been presented by Dr. C. Hart Merriam in a vice-presidential address to the National Geographical Society of Washington, under the title, 'Laws of temperature control of the geographical distribution of terrestrial animals and plants' (Nat. Geogr. Mag., VI., 1894, 228-238). The life zones of the United States, as mapped two years ago (Ann. Rep. Sec'y Agriculture, 1893), are now shown to be limited northward by the total quantity of heat during the season of growth and re-

production; and southward by the mean temperature of the hottest part of the year. The 'total quantity of heat' is measured by the sum of the excesses of mean daily temperature over 43° ; this temperature being taken as marking 'the inception of physiological activity in plants and reproductive activity in animals.' The 'hottest part of the year' was arbitrarily limited to the six hottest consecutive weeks of summer. The life zones, the northward control, and the southward control are shown on three maps; and the accordances between the controls and the zones are truly surprising. The peculiar over-lapping of boreal and austral types along the Pacific coast, hitherto not clearly understood, is thus shown to obey the same controls as those which elsewhere keeps these types apart; the western coast being exceptional in having a great total quantity of heat, but a very mild summer. The dependence of these temperature controls on general geographical features offers a beautiful illustration of the general principles of climatology.

HARRINGTON'S RAINFALL CHARTS OF THE
UNITED STATES.

A QUARTO paper of text and tables and a large atlas of charts, entitled 'Rainfall and Snow of the United States, Compiled to the end of 1891,' by Mark W. Harrington, chief of the Weather Bureau, has lately been issued as Bulletin C, of that office. It is based on all available records, of very different periods and values, but constituting the best body of material now in hand for the study of precipitation in this country. The charts exhibit the monthly, seasonal and annual rainfall, monthly maxima and minima, and many other details. The text calls attention to the chief features in the distribution of precipitation, both in place and season. The unusually heavy rainfall in the southern Appalachians, averaging over sixty inches, and exceeding ninety inches in 1892 at one station, is a new fea-

ture. It may be doubted whether the rainfall of the more mountainous belts is in general sufficiently represented. For example, Pike's peak is the only mountain meteorological station in Colorado, and its rainfall (30") is greater than that of any other station. It might therefore be taken as indicating the rainfall on the mountains of Colorado in general; but, although there are many other lofty peaks, the isohyetal line of 30 inches does not include them. One might, to be sure, in the absence of direct observations, feel some hesitancy in asserting that these other summits actually have a 30-inch rainfall; yet one might feel equal hesitancy in asserting, as the charts do so emphatically, that the high peaks in general have not a 30-inch rainfall. It is stated that "in general the rainfall decreases also with the elevation above sea level;" and the decreased precipitation in passing westward across the Great Plains is taken as an illustration of this generalization. It is questionable whether the illustration is pertinent; for other controls, such as distance inland and relation to mountain ranges, are here presumably of much greater importance than increasing elevation. It is to be regretted that, in the interests of a consistent terminology, Florida should be cited as a region of 'subtropical' rainfall. Florida is a region of summer rains; while regions of subtropical rainfall always have their maximum in winter, as in the region originally so named by Dove, around the Mediterranean, and again with equal distinctness in California, Chili, South Africa and South Australia. The southeastern coast of Asia has a summer rainy season, like Florida; and Florida might therefore with some justice be likened to the regions of monsoon rainfall, but this would hardly do justice to its other relations. As a matter of fact, no technical name has yet been suggested for seasonal rainfall of the Florida kind.

BAROGRAPH RECORD DURING A TORNADO.

THE general fall of pressure during the passage of cyclonic storms is an old observation. The short-lived rise of pressure during the onset of a thunderstorm is of more recent detection. The inferred very low pressure in the funnel of a tornado has never been tested by direct observation, unless the tracing of a barograph at Little Rock, Arkansas, on October 2, 1894, may show an effect of this kind. The tornado passed over the Weather Bureau station at 8:28 P. M. of that day, and although the upper story of an adjacent building was blown upon the station, the instruments on its roof generally destroyed, the windows blown in and the furniture drenched with rain, the barograph bravely continued its record; and its interesting curve is reproduced in the Monthly Weather Review for the month in question. As the tornado passed there was a momentary fall and rise of 0.38 inch. Shortly afterwards the storm passed over the gas works, and all the lights in the city went out as if by relief of pressure from the gasometer. As soon as the cloud passed, the tank settled again, the pressure was resumed, and the gas jets could be lighted. Professor Abbe, editor of the Weather Review, points out that the sudden change of pressure recorded on the barograph curve may have been merely a local effect of decrease of pressure by wind suction up the chimney, followed by restored pressure when the windows were broken in; so the inferred low pressure of the tornado funnel still eludes unquestionable record.

NEW YORK STATE WEATHER SERVICE.

THE fifth annual report of the New York State meteorological bureau and weather service, of which Professor E. A. Fuertes, of Cornell University, is director, is perhaps the most elaborate and valuable of any of the State service reports yet issued. Be-

sides the summaries of monthly reports for all stations for 1893, with good charts of temperature and rainfall from records at about one hundred stations, there is a comprehensive chapter on the climate of the State, by E. T. Turner, meteorologist to the State service, with a number of interesting plates and charts. For example, the curves of daily mean temperatures and pressures exhibit to a nicety the greater fluctuations of these elements in the winter, when cyclonic action is increased, than in summer, when it is diminished. A neatly tinted map, shaded for elevation, gives a clear idea of the general relief of the State. The few elevated stations in the Adirondacks have a higher mean winter temperature than those in the St. Lawrence valley, more than a thousand feet lower; a notable example of this inversion having occurred under an anticyclone on December 8, 1890, which is illustrated by a special chart. Nocturnal winds, flowing northward past Ithaca to Cayuga Lake, are described as characteristic of the valleys of the southern plateau; they occur on clear nights, both winter and summer, beginning one or two hours after sunset and reaching a velocity of about eight miles an hour before morning. The thickness of this current, as determined by balloons, is only from fifty to a hundred feet. Apart from the immediate value of so well managed a service as this, in the way of displaying weather signals and distributing crop reports, it deserves hearty support from the State in its long task of collecting and discussing authentic climatic data. The number of reporting stations should, however, be largely increased, and for this purpose the service cannot do better than foster the adequate teaching of meteorology in the public schools, both by the publication of special articles serviceable to teachers, and by making these articles known at teachers' and farmers' institutes.

ARGENTINE METEOROLOGICAL REPORTS.

AMONG the most elaborate discussions of meteorological observations published in America are those of the Argentine Meteorological Office, under the direction of Walter G. Davis, whose headquarters are at Cordova, in the middle of the pampas. The latest volume issued, number IX., is in two parts; the first giving the original observations at Cordova since 1872, the second giving the mean values determined from this important series of records. A notable climatic feature is the occurrence of a wet summer, October to March, and a dry winter, April to September. The summer rains are chiefly supplied by thunderstorms, yet curiously enough the rains exhibit both in quantity and in number of occurrences a distinct afternoon minimum and an early morning maximum; but the scale of cloudiness has its maximum toward midday, and in January in mid-afternoon. High barometric pressure confirms the continental quality of the winter dry season. Westerly winds are rare; northeast and southeast are common, the latter flowing feebly through the night, the former actively through the afternoon; and thus indicating the left-handed or austral deflection that might be expected with increased velocity in the southern hemisphere. The strong diurnal winds last from ten to five o'clock in late summer, but only from noon to three in midwinter; while the duration of the quiet winds of night plainly varies with the period from sunset to sunrise. Although the text and tables are most elaborate, the treatment of the subject is local, numerical and climatic, rather than general, descriptive and meteorological.

THE SPECIOUS TERM, 'REFORESTATION.'

THE hard times lately reported as afflicting some of the Western States in the debatable belt, where agriculture is an uncertain occupation, recall by contrast the

over-confident opinions, so freely uttered by 'experts' before Congressional committees, concerning the improved climatic conditions that might be expected over the Great Plains as settlement advances. Governmental science will, we fear, suffer severely when the inaccuracies of this quasi scientific testimony are understood. Hardly less misleading than the loose phrases concerning 'the underflow,' from which an inexhaustible water supply has been looked for, is the term 'reforestation,' used with the implication that the barren plains of to-day have been forested in the past. One official has testified: "By the destruction of the forest which originally covered this region, the very condition of its existence and of its natural recuperation was destroyed; and thus, in a reverse manner, reforestation of parts by artificial means may make natural reforestation over the whole area possible by and by. . . . Reforestation on the plains and forest preservation on the mountains is of greater national concern than the location of irrigation reservoirs." There is no shadow of evidence that the Plains have ever been forested since their geographical surroundings were like those of to-day. It is a most gratuitous assumption to use the term 'reforestation' in writing of the Plains. It does harm to those who are tempted to settle there by these and other over-favorable views concerning the climate of the sub-arid region; and it discredits governmental science by exposing it to so easy contradiction.

W. M. DAVIS.

HARVARD UNIVERSITY.

ANNUAL RECEPTION OF THE NEW YORK ACADEMY.

THE New York Academy of Sciences last year instituted a series of annual receptions, suggested by the famous *conversazione* of the Royal Society of London. The first Reception was held in the Library of Co-

lumbia College. The second, held upon March 14th, in the Galleries of the American Fine Arts Society, was much larger and more successful than the first, including 331 separate exhibits, grouped under sixteen branches of Pure and Applied Science. In the South Gallery were placed Physics, Electricity, Astronomy, Mechanics and Chemistry; in the Middle Gallery, Photography, Psychology and Mineralogy; and in the Vanderbilt Gallery, Zoölogy, Palæontology, Human and Comparative Anatomy, Botany and Geology. Each branch was under a Chairman who had entire control of the the general arrangements, and while the exhibits were largely from the educational institutions and museums in and around New York a number of most interesting objects were sent from considerable distances, such as the photographs from the Allegheny and Lick Observatories. Among the very large number of excellent exhibits it is only possible to mention a few of the most novel.

Mr. Charles A. Post, of the Strandhome Observatory, had charge of the astronomy, in which he displayed photographs of star spectra between F. and D. from the Allegheny Observatory, glass positives of comets and the Milky-Way from the Lick Observatory, and a number of new spectroscopic and other astronomical instruments. Professor Mayer, of Stevens' Institute, had charge of the physical section, in which were shown his series of Chladni figures preserved in sand, illustrating the errors of older figures and the accuracy of Lord Rayleigh's theoretical deductions. A number of new physical instruments for spectroscopic and sound measurement were exhibited in operation by Professor Hallock from the Columbia Physical Laboratory. Professor Crocker had charge of electricity, in which were shown Professor Pupin's machines for producing alternating currents for multiplex telegraphy and other purposes, also E. H. Dickerson's acetylene illuminat-

ing gas produced from calcium carbide made in an electric furnace. The mechanical exhibit was in charge of Professor R. S. Woodward, and included models of the international prototype metres and kilogrammes, and several pieces of new mechanical apparatus. In the mineralogical exhibit, arranged by Dr. L. P. Gratacap, of the American Museum, was a series of Babylonian and Assyrian cylinders, illustrating the different minerals employed between 4000 and 300 B. C.; also an extensive display of new types of American minerals. The photographic exhibit, in charge of Dr. Edward F. Leaming, besides new apparatus from Zeiss of Jena, included all the recent applications of photography in color printing, and the combination of colors in lantern projection shown by the inventor, Frederic E. Ives, of Philadelphia. Dr. Leaming's micro-photographs of nervous and cellular tissues and of bacteria formed an important feature of this exhibit. The exhibit in experimental psychology was contributed by the department of experimental psychology of Columbia College. The apparatus has been recently made for the college, and with the exception of the harmonium was designed by members of the department. The harmonium was designed by von Helmholtz and Ellis to give pure intervals in place of the equal or tempered intervals used in musical instruments with fixed keys. The other apparatus shown was: (1) an instrument which measures the duration, intensity and area of lights, now being used for the investigation of after-images; (2) an instrument which measures the time (to 0.0001 sec.) objects are exposed to view, now being used to study the legibility of letters and types, and in an altered form to measure the perception, memory and attention of school children; and (3) a new chronograph of very high speed with fixed drum and movable carriage. Physiology was represented by a number of special ex-

hibits made by the Chairman, Prof. J. G. Curtis, and by Professor Thompson, of the New York University. The botanical exhibit, arranged by Dr. Carlton C. Curtis, included an extensive display of new plants from North and South America, Dr. Schneider's studies of lichens, and the morphological and embryological studies carried on under the direction of Dr. Curtis, by the students of Dr. Curtis and of Professor Gregory of Barnard College.

The American Museum contributed two extensive exhibits in Zoölogy and Palæontology, arranged by Professor Allen and Professor Osborn. The Zoölogical exhibit illustrated the rapid improvement in the modern methods of taxidermy by a series of comparisons of specimens of work just completed and that of ten years ago, the most notable being the preparation of the chimpanzee 'Chico' by Mr. Rowley. The results of the current field explorations of the Museum and the natural methods of group mountings were also shown by extensive exhibits. In vertebrate Palæontology the chief feature was three panels showing the stages in the evolution of the horse; first, of the modern skeleton in comparison with that of *Hyracotherium venticolum*, from the Cope Collection recently acquired by the Museum; second, a complete series of feet, and third, a complete series of skulls. Two newly discovered ancestral forms of Titanotheres from the Eocene were also shown, displaying the first rudiments of the great horns which characterize the latest surviving members of this group. The most noteworthy feature in invertebrate Palæontology was the collection shown by Messrs. Van Ingen and Matthew, of what appears to be a sub-Olenellus fauna from the lower Cambrian, in other words, the oldest fauna thus far discovered. Under Geology, as arranged by Professor J. J. Stevenson, was shown an extensive series of eruptive rock from the pre-Cambrian volcanoes along the

Atlantic coast, besides many results of Prof. Kemp's field work. The Columbia biological laboratory contributed to the zoölogical exhibit a full series illustrating the Golgi silver nitrate nerve-cell preparations, together with the results obtained by the 'lithium-bicromate' and 'formalin' modification introduced by Mr. Strong, exhibitor. Professor E. B. Wilson, displayed his new series of fertilization stages of the Sea-Uchin, proving that the archoplasm is entirely derived from the spermatozoon. All of these cytological exhibits were accompanied by micro-photographs taken by Dr. Leaming. Dr. T. H. Cheeseman had charge of the bacterial exhibit, including principally a display of preparations by the new formalin method, and an illustration of the stages in the preparation of the anti-toxine treatment of diphtheria. In Anatomy, Professor Huntington displayed a unique series of 194 preparations, showing the comparative anatomy of the caecum and vermiform appendix throughout the vertebrata.

The Exhibit was open throughout the afternoon to students, and throughout the evening to guests of the Academy. The admirable arrangements were largely due to Professor Hallock, Chairman; Dr. Dean, Secretary, and Professor Lee, Chairman of the Reception Committee. The event fully justified the large amount of time and care which was given to its preparation, and in the opinion of all those who were present will prove a great stimulus to the various branches of research now in progress in New York. It has been informally decided to renew these receptions from year to year, and to attempt to give them a more national character by inviting exhibits from other parts of the country. The galleries of the Fine Arts Society, with unlimited wall space for the exhibition of charts and diagrams, with admirable means for electrical illumination for microscopic and other purposes, and

with very extensive floor space for tables, is exceptionally adapted to the needs of an extensive exhibition of the annual progress of science.

HENRY F. OSBORN.

CORRESPONDENCE.

AN INTERNATIONAL SCIENTIFIC CATALOGUE AND CONGRESS.

EDITOR OF SCIENCE: *Dear Sir*:—In considering your very courteous invitation to contribute something of present interest to your valuable journal, it has occurred to me that I could not perhaps do better than to follow the example set in your issue of Feb. 15th, by the distinguished representatives of my *alma mater*, Prof. Bowditch and his committee, in their report to the Harvard University Council on the circular of the Royal Society, respecting the proposed International Catalogue. My letter of reply to this circular does not, as you will see, in any way conflict or interfere with the recommendations made in that excellent report. It deals almost entirely with other points in the circular which are not directly noticed in the report.

Should the suggestions which I have ventured to make, especially in regard to the meetings of an International Congress of Science in connection with the proposed Catalogue, be finally approved and carried into effect, they may lead to practical results of great importance. Such meetings, held from time to time—perhaps in various cities of the two continents—may not only bring together from all parts of the globe the most eminent votaries and friends of science in fraternal conference, but may help not a little, with other influences which are now constantly at work, in converting Tennyson's 'parliament of man' and 'federation of the world' from a poetical vision into a beneficent reality.

Yours faithfully,

HORATIO HALE.

CLINTON, ONTARIO, CANADA,

May 30, 1894.

GENTLEMEN: As you have honored me by addressing to me a copy of your important circular letter, in which you solicit from the recipient the expression of his views respecting the establishment of a 'Central Office or Bureau,' by 'international coöperation,' for the purpose of preparing and publishing, at brief intervals, a catalogue of all scientific publications of every description (whether appearing in periodicals or independently), I cannot, in due courtesy, decline to offer in response such considerations as occur to me, however inadequate they may seem in comparison with others which will reach you from better qualified correspondents.

That the proposed scheme is both highly desirable and abundantly feasible cannot reasonably be doubted by any one who is aware of the immense increase in the number of scientific publications of late years, and the equally rapid increase of scientific associations, public libraries and high institutions of learning, for most of which such a catalogue will be found of very great advantage and ultimately a necessity. The most convenient 'method of inaugurating the scheme' would seem to be by first ascertaining the probable annual cost, which can readily be judged through the experience already gained by the Royal Society in the publication of its annual 'Catalogue of Scientific Papers,' and then by appointing in each (presumed) contributing country, under some appropriate title, an 'Aid Bureau,' which should be an existing institution of high standing, and one that either is already, or can easily be placed, in touch with the chief scientific associations, colleges and public libraries of the country, and can ascertain the amount of contributions which could be obtained from them. In the United States, for example, such a suitable Aid Bureau at once presents itself in the Smith-

sonian Institution. In Canada and in each of the other British colonies which possesses a Royal Society, this Society will naturally assume the office. In every other country some institution of similar position and character will readily be found.

As to the place of the Central Bureau, and the directing authority under which it should be inaugurated, one would suppose that there can hardly be two opinions. That this place should be London, and this authority the Royal Society of England, would seem to be necessary conclusions from the existing circumstances, at least at the outset. Both place and directory might, of course, be changed hereafter, if this should be found desirable.

It would seem specially advisable, for the purpose of arousing and maintaining an interest in the object in view, and of ensuring the cordial coöperation of all concerned in the work, that general meetings should be held—either annually, or biennially, or triennially, as might be found most convenient—of representatives of all the contributing bodies, or at least of all that contribute a certain defined amount to the fund. Such meetings might be held either at the place of the central office or at other places, as might be decided, from time to time, by the assembled representatives. Such an assemblage would constitute an International Congress of Science, possessing much of the character of those congresses of geologists, of anthropologists, of Orientalists, of Americanists and the like, which have of late years been found so popular and useful, but differing from them in possessing to some extent a representative character, and with it a defined purpose and authority. Its purpose would be that of maintaining a connection among the students of all the sciences throughout the globe, not only by personal acquaintance or correspondence, but also and especially through the medium of the Central Bureau and the Catalogue,

which would be directly under the authority of the Congress. In general it may be said that this Congress would speedily become for the whole civilized world what the modern Association for the Advancement of Science is for its own country; with the important difference, however, that the Congress, besides the personal influence of its meetings and the interest that would attach to the volume recording the proceedings of each meeting, would have the much greater influence and usefulness resulting from the permanent activity of its Central Office and the frequent issue of its catalogue of scientific publications.

As regards the 'character of the work to be carried on in the central office,' there seems little to be added to the suggestions of the circular. The final paragraph, in which it is suggested that "arrangements might be made by which, in addition to preparing the catalogue, scientific data might be tabulated as they come to hand in the papers supplied," could perhaps be enlarged, with much advantage, into the creation of a special 'Bureau of Scientific Correspondence,' to which any member of a contributing body might apply for information on questions of fact. As is well known, it constantly happens that through the unavoidable ignorance in which, to a large extent, students of science have heretofore remained of one another's actions, supposed new discoveries are announced and resulting theories suggested, which have been already made known elsewhere. Every such student will appreciate the advantage of being able to refer to a bureau of specialists for information on doubtful points of this description.

On the question of 'the language or languages in which the catalogue should be published,' there would seem to be little difficulty in deciding. If English and French should be jointly selected for this purpose, there would probably be no ob-

jection from any quarter. There are very few students of science who are not familiar with one or other of these idioms. And the choice will be made generally acceptable by the fact that they very fairly represent the two great Indo-European branches of language, the Teutonic and the Romanic, in which at least nineteen-twentieths of all scientific publications are likely to appear for many years to come. If the time should arrive when the addition of another language may seem advisable, it can readily be made by the proposed congress or any other authority then governing the Central Bureau.

It would, of course, be understood that the deliberations of the congress and of its sections, and the papers read before them, would not necessarily be restricted to the two idioms of the catalogue, but might be in any language which the congress or any section should at the time decide to admit. This decision, it may be assumed, will always be considerate and liberal to the largest possible degree.

I am your obedient servant,

HORATIO HALE.

The Secretaries of the Royal Society,
BURLINGTON HOUSE, LONDON.

SCIENTIFIC LITERATURE.

A Primer of Mayan Hieroglyphics: By DANIEL G. BRINTON. Ginn & Co., Boston. 1895. 8°, pp. 152.

The public mind is becoming more and more interested in the archæology of Mexico and Central America. At once symptomatic of and a cause of increasing this interest are the numerous explorations of recent years, the exhibition from this region collected for the Exposition, and the notable works published in Mexico, Spain and Germany in connection with the Quadri-centennial celebration of America's discovery.

Nevertheless, students in our own country are somewhat at a disadvantage in this

matter. The literature of the subject is not only scattered, but is in various languages, —Spanish, French and German—and it is not easy to keep track of progress. This little volume, by one who has devoted years to the study of 'the American Race,' and who is a specialist in the languages, literature and life of Isthmian people, will therefore be particularly welcome. It not only summarizes the work done, but is a guide to the original publications wherein discussions have been published.

The Mayan hieroglyphic system was in wide-spread use, being represented on monuments of Yucatan, Tabasco, Chiapas, Guatemala and Western Honduras. Though so often compared with that of the Aztecs, it is certainly more fully developed. On the whole, it can not be said to comprise a very great number of simple elements; these, however, are variously combined and united, and the composite *glyphs* are many. The material for study varies. There are books —Codices—written on long strips of paper, which were folded screen-wise. Four such codices are known, called the Codex Troano, C. Cortesianus, C. Peresianus and C. Dresden; they are in libraries at Madrid, Paris and Dresden. There are also mural inscriptions cut in stone; elaborate series of calculiform characters chiseled on altars and monoliths; pretty cartouches engraved on amulets or ornaments; symbols or characters painted on pottery; glyphs on hard, firm grained boards of wood like those from Tikal.

Are these characters ideograms or phonetic? There are those who believe they are entirely the former; there are others who claim that many are phonetic. Some admit that both occur. Brinton himself invented, years since, the word *ikonomatic*. He believes that there are some true ideograms in the Mayan texts; very many of the characters, however, he believes are in the nature of rebuses. They still betray

their origin as pictures, but are not to be considered as pictures but as characters representing sounds—either the name of the object pictured, used as a phonetic element, or a sound suggested by that. Looking at the whole field he recognizes three groups of elements:

1°. Arithmetical signs, numerals, numerical computations—Mathematical elements.

2°. Pictures of men, animals, fantastic beings, ceremonies, objects, etc.—Pictorial elements.

3°. Graphic elements, proper.

To each of these our author devoted a division of his work.

Numbers, day signs, month signs, are so common in the Codices as to suggest that these are mainly time-counts. The Mayas counted by twenties, and had distinct terms for higher orders of numerals up to at least the sixth power of twenty. They were able to write numbers, even the highest; dots were units, lines were fives, and there were special characters for the score and for higher orders. Förstemann appears to have found that they had a zero sign, and that numbers were written upward, a higher order of units being indicated by position. Maya time divisions are complicated, and a variety of numbers are used in their tables. Thus the numbers 4, 5, 13, 20, 24, 52, 65, 104, 115, 260 and others occur in grouping days and months into years, cycles, &c. The Maya idea of a complete number seems to have been the multiple which should contain all these numbers used in reckoning days. Förstemann claims to find the number 1,366,560 days (= 3744 years) in the Dresden Codex. The eminent German believes the Codices were largely astronomical treatises, and in this opinion Brinton agrees. This is, as he says himself, world-wide distant from the theories of Seler or Thomas. Aside from theories, however, Brinton presents the necessary information, which is gained so far, regarding numbers as they

occur in the Codices; he also presents briefly and simply a sketch of his own and Förstemann's astronomical views, and calls attention to the fact that other views exist.

The bulk of the pictorial elements have to do apparently with religious ideas and represent deities, ceremonies or religious objects. Schellhas' paper upon the representations of the gods in the Maya writings will ever remain the foundation for such study. In some cases Brinton agrees with Schellhas; in others he reaches a different identification. A considerable number of the gods are satisfactorily made out; that is certain. Influenced as he is by Förstemann's strongly astronomic views, Dr. Brinton feels that among these representations of deities there should be some of the planet Venus. In all parts of the Codex Troano there are many curious representations of a bee; this he connects with Venus as the *evening star* and merges the latter into the old woman, so often represented with Cuculcan, as the earth goddess. In all the Codices, Brinton counts 825 representations of male deities and 125 of females; he believes that 638 of these have been made out. He says: "This is a satisfactory result and shows that, as far as these pictographs go, the contents of these once mysterious volumes are scarcely an unsolved enigma."

The graphic elements are and long must be the most difficult. The signs of the days and months have long been known; those of the cardinal points have recently been pretty surely identified; the 'monograms' of the gods are fairly agreed upon. In studying the graphic elements the composite glyphs must be analyzed. They consist usually of one main element, with infixed, prefixed, superfixed, postfixed or sub-fixed secondary elements. Then one must, if possible, find the things which these simple elements originally represented. The ideogrammatic force may be gone, but

the name of the thing pictured may suggest the phonetic value. The work is not easy. Brinton takes up one after another such as have been most studied, or for which he has a meaning to suggest. That we are still far from final conclusions is shown by the variation in interpretations of different authors. A group of signs which Seler considers are derived from 'man' and signifying 'person,' others distribute among crescent, ear, a serpent's mouth, eye and eye-lash, comb, claw, feather, part of a plant, etc. One of the commonest of glyphs, believed by Brinton to be derived from a picture of a feather ornament, and with the phonetic value of *yax*, and meaning (by metaphor) green, new, young, strong, fresh, virile, etc., is by others variously identified as representing a gourd, a tree, a *zapote* fruit, the phallus, etc. Such diversity of opinion is not discouraging; it only shows that much remains to do.

Our author does not slavishly follow authority. The bee-god sign and the *yax* character already mentioned show independence. His recognition of the *pax* (drum) sign is ingenious and probably strong. He introduces much new argument in identifying the deities. His suggestions in reference to day and month signs are thoughtful.

In so new a field we must have conflict of ideas. Dr. Brinton fairly aims to present all sides. The Primer shows the real position of knowledge on the question as resulting from the labors of Seler, Thomas, Schellhas, Förstemann and a host of other students. It is a good summary of present knowledge with a considerable addition of new and thoughtful material. It points the way, gives suggestion and help. The beginner must have the book, and every worker must recognize that Dr. Brinton by its publication puts all under genuine obligation, whether they agree with all his arguments or not.

FREDERICK STARR.

UNIVERSITY OF CHICAGO, Feb. 16, 1895.

Steam and the Marine Steam Engine. By JOHN YEO. London and New York, Macmillan & Co. Illustrated. 105 Engravings. Pp. xiv, 196. 8vo. \$2.50.

This is a book written by a Fleet Engineer of the British Navy, for use at the Royal Naval College and elsewhere, embodying lectures prepared by Mr. Yeo for a course addressed to Executive Officers. It is thought that it may prove also useful for officers of the merchant service, and for students in engineering. It is a very compact presentation of the subject, and, as might be expected, coming from an officer of long service, abounds especially in well-made illustrations exhibiting the construction of the marine engine in its various usual forms and all its details. Of these engravings we can hardly speak too highly. They are largely reproductions of the diagrams and drawings employed in the lecture-room, and reductions of working drawings made especially for the book. The introduction gives an abridged account of the history of the marine engine, from the time of Watt to the present, and indicates, in a general way, the methods of improvement which have brought about the enormous gain, meantime, in economy and power of steamships.

The structure of engines and boilers, and of all their minor parts and accessories, including the slide-valve and its gearing, indicator-diagrams and their interpretation, and the condenser, the screw, and the powering of ships, are subjects treated of with evident knowledge and with brevity and accuracy. Little space is given to theoretical discussions of the thermodynamics or of other principles, mathematical or physical, illustrated by the action of the steam engine, and the special value of the book lies in its presentation of the forms of parts and its descriptive account of the machine. It is well made; paper, type, style and binding all being excellent; and the publishers

are to be congratulated on their good work in this respect. R. H. THURSTON.

The Life and Correspondence of William Buckland, D. D., F. R. S. Some time Dean of Westminster, twice President of the Geological Society, and First President of the British Association. By his daughter, MRS. GORDON. With portraits and illustrations. New York, D. Appleton & Co. 1894. Post 8°. Pp. 288. \$3.50.

To those who were 'brought up,' geologically speaking, on perhaps the most weighty and yet brilliant of the Bridgewater Treatises, 'Geology and Mineralogy considered with reference to Natural Theology,' and are familiar with the prolonged struggle for existence undergone by the 'noble subterranean science' in the first half of our century, this life of the English participant in the contest will show what a force he must have been in the intellectual and scientific life of his time.

Dean Buckland was one of the creators of the science. Himself inspired by the teachings, though at second-hand, of William Smith, 'the father of English Geology,' he became the teacher of Lyell, of Murchison, of Etheridge, Daubeny, Egerton and Lord Enniskillen. As early as 1809, when a Fellow at Oxford, he had by his energy in collecting, his contagious enthusiasm, and his bold and effective advocacy of the infant science, produced a sort of panic in the minds of those who would have gladly strangled this newly born science.

The philosophic calm and classical serenity of the Oxford dons was sorely vexed and disturbed by the young savant. "Some dreaded lest his example should drive the *amœnitates academicae* out of fashion." When his shorter journeys on British soil finally led to a longer excursion to the Alps and to Italy, one of the elders is said to have exclaimed: "Well, Buckland is gone to Italy; so, thank God, we shall hear no more of

this geology." But young Buckland's zeal, energy, overflowing humor and eloquence, led to his appointment in 1813 to the Readership of Mineralogy, and in 1819 a Professorship of Geology was created for him.

He went on triumphantly in his career of advancing and popularizing his favorite science, overcoming objections and theological narrowness either by a joke, a hearty laugh, a strain of lofty eloquence, or by earnestly insisting that the study of geology, so far from being irreligious or atheistic in its consequences, had a tendency to confirm the evidences of Natural Religion, and that there could be no opposition between the works and the word of God.

His humor, quick wit and overflowing jollity or playful fancy in the lecture room were contagious. His field lectures were largely attended, and many are the stories told of his apt illustrations on these occasions, as well as of some of his adventures on his geological excursions. They are illustrated by rhymes and by comic pictures from the pen and pencil of his fellow geologists. As an example of his graphic mode of explaining the earth as understood in his day, it is said "He compared the world to an apple-dumpling, the fiery froth of which fills the interior, and we have just a crust to stand upon; the hot stuff in the centre often generates gas, and its necessary explosions are called on earth, volcanoes." When riding towards London with a friend on a very dark night, they lost their way. "Buckland therefore dismounted, and taking up a handful of earth, smelt it. 'Uxbridge,' he exclaimed, his geological nose telling him the precise locality." Mr. Etheridge tells the story of Buckland when travelling in Scotland, "in order not to shock the feelings of the Scotchmen on Sunday, carrying his hammer up his sleeve." Ruskin, who was an undergraduate of Christ Church when Buckland was not only

the Professor of Geology, but also a Canon of the Cathedral, writes in his 'Præterita : ' "Dr. Buckland was extremely like Sydney Smith in his staple of character ; no rival with him in wit, but like him in humor, common sense, and benevolently cheerful doctrine of Divinity . . . Geology was only the pleasant occupation of his own merry life."

With these characteristics of head and heart, a sane mind in a sound body, it may be imagined what an immense impetus Buckland gave to the growth and development of the young science. He was the first president of the Royal Geological Society, and the first president of the British Association for the Advancement of Science, which he invited to meet at Oxford. His papers and memoirs were not numerous, though upwards of fifty, besides three general works ; perhaps his volume on Caves, 'Reliquiæ Diluvianæ,' was of most lasting value. He was, though at first rejecting Agassiz's theory, one of the first to recognize the fact of the former existence of glaciers in Great Britain.

Buckland was born in 1784 and died in 1856. His last scientific paper appeared in 1849. In 1845 he was appointed by Sir Robert Peel to the deanery of Westminster, and one of the first things he did was to introduce a system of pipe-drainage in Westminster Abbey, the first of its kind ever laid down in London, and which led to the disuse of cesspools and brick sewers throughout that city. He was, then, not only dean and a doorkeeper in that palatial house of the Lord, but he applied his scientific knowledge to the thorough cleansing of its foundations. Cleanliness with the good dean was evidently a synonym of godliness. His sermon delivered in 1848 on the words, 'Wash and be clean,' was almost the first contribution to sanitary science, a subject in which he was far ahead of his time. His interest in medical science, in general

charity and philanthropy, in building churches and schools, was informed and enlightened by his early geological training and advanced ideas. When, in 1846, the famine crept over Ireland, and even into England, he met the difficulty while living in his summer house at Islip, and among other wise and kindly acts he supplied the village shops with sacks of hominy and Indian corn. Here also he built a recreation room for the village lads, the forerunner of our boys' clubs and kindred associations.

The story of Buckland's brilliant and useful life is in most respects well told ; the illustrations are amusing and often instructive, and we warmly recommend the book as most entertaining reading for geologists, young and old, and indeed for all lovers of nature. A. S. PACKARD.

GEOLOGY.

Report on the Iron Mountain Sheet, by Arthur Winslow, E. Haworth, Frank L. Nason and others. ARTHUR WINSLOW, State Geologist, Mo. Geol. Surv. 1894.

This is the third number of the same series of reports as the Bevier sheet and covers an area of about 250 square miles in portions of Iron, St. Francois and Madison counties. As in the others, the principal feature is the map showing the topography and the geology. This was constructed by Messrs. Haworth, E. H. Lonsdale and C. F. Marbut and is similar in scale and contour interval to the one described above. It is also accompanied by a sheet of columnar and cross sections, showing the structure of Iron mountain and Pilot knob. In the text the peculiar topography of the region, as well as the other physiographic features, are described by Mr. Winslow. Mr. Haworth contributes the portion on the geology of the crystalline rocks and Mr. Winslow that on the geology of the Paleozoic rocks. The economic geology of the iron

ores is treated of by Mr. Frank L. Nason, the author of the report on Iron Ores, published by the Missouri Survey in 1892. The report on the building stones is by Mr. G. E. Ladd.

The first of this series, viz., the Higginsville sheet, was issued in folio form, the text being printed on large sheets of the same size as the maps, somewhat similar to the sheet reports issued by the United States Geological Survey, except that the former was stitched. In these later reports the text is printed in octavo form, while the map with the sheet of sections and a sheet of brief explanatory matter is issued in a folio cover separately. A portion of the edition, however, has the map and sheet of sections printed on thin paper, folded and inserted at the end of the pamphlet. Thus this series of reports have been issued in three forms, which may serve to assist in deciding the best form for publication of future reports for different purposes.

J. D. R.

Preliminary Report on the Rainy Lake Gold Region. By H. V. WINCHELL and U. S. GRANT. Geol. and Nat. Hist. Survey of Minn., 23rd Ann. Rept., pp. 36-105. Jan., 1895.

Considerable excitement has been caused during the last year by the reported discoveries of rich gold-bearing veins at Rainy Lake, on the northern border of Minnesota, and accordingly an examination of this region was made by the Geological Survey of the State. The veins occur in more or less crystalline rocks of Pre-Cambrian age, and can be classed as: (a) fissure veins, (b) segregated veins and (c) fahrbands. The most promising part of the district is in what is known as the Seine River country, in Canadian territory, where there are true fissure veins which furnish a good quality of free-milling ore. Actual mining was conducted during the last summer in but one

place—at the Little American mine, in Itasca county, Minn.; but prospecting and exploitation have been carried on in a number of other places. As yet the development is insufficient to warrant the positive assertion that profitable gold mining can be conducted in the Rainy Lake district, but in several localities the prospects are full of encouragement and promise. The report is accompanied by a geological map of the region.

NOTES AND NEWS.

BIOLOGICAL.

THE January number of the *Geological Magazine* contains a note by Professor H. G. Seeley, on the skeleton of *Pareiasaurus bairdi*. This remarkable animal is one of the Anomodontia which Professor Seeley has been making known to science from the Karoo or Upper Triassic beds of South Africa. He observes that while there are superficial characters which parallel the labyrinthodont amphibia, there is no doubt the animal finds its place among true reptilia. It is remarkable for the number of sharp recurved teeth upon the palate, together with the teeth in sockets on the alveolar margins of the jaw. Notwithstanding the extremely heavy build of the animal, there is much that recalls the lowest mammalia in the shoulder girdle and the fore and hind limbs. It is the shoulder chiefly which indicates this affinity with the Monotremata. The new knowledge which this animal supplies gives a meaning to the ordinal term by showing the resemblances in the teeth to various groups of animals which would not have been suspected from the reptilian structure of the skull, or the mammalian structure of the extremities. The skeleton is figured, as it now appears mounted in the British Museum, of a total length of seven feet, nine inches. It would be difficult to imagine a more grotesque quadruped. Those who have had experi-

ence in mounting stone skeletons realize what an extremely difficult undertaking it is, and will judge of this particular mount with leniency; at the same time, an examination of the figure, or still more of the original specimen in the Museum, shows that the limbs have been placed in an unnecessarily awkward and impossible position. There was no necessity for placing the hind limbs so far in front of the center of gravity of the posterior half of the body, or for turning the fore feet so far inward that locomotion in a forward direction would be rendered impossible.

THE latest Bulletin from the Museum of Comparative Zoölogy is Professor Agassiz's '*Reconnaissance of the Bahamas and of the elevated coral reef of Cuba in the steam yacht Wild Duck, January to April, 1893,*' covering 200 pages, 47 plates, and a large number of illustrations in the text. It contains a complete survey of this remarkable coralline region, and is not only full of original observations and notes of great value, but brings the region far more easily within the reach of future biological and geological exploration. As the survey in the *Wild Duck* continued over only four months, it has rather the reconnaissance character of that made by Professor Agassiz in the '*Albatross*,' on the west coast of South America, than the thoroughness of the author's work upon the *Blake*. The *Wild Duck* was placed at Mr. Agassiz's disposal by Mr. John M. Forbes, and while not fitted like the Government vessels for deep sea work, proved to be admirably adapted for cruising on the Bahama banks, her light draft enabling her to go to every point of interest and to cross and recross the banks where a larger vessel could not follow. The greater part of the Bulletin is descriptive. A number of important problems are discussed, the author closing with an expression of his own views upon the formation of coral reefs, as con-

firmed by this exploration of the Bahamas: "Substitute subsidence for rising land and remembering that reef coral will not grow at a greater depth than twenty fathoms, we eliminate subsidence as a factor unless we are prepared to accept or imagine a synchronism between the growth of corals and subsidence in a great number of the districts in which they flourish, of which we have no proof."

WELDING OF IRON.

At the last meeting of the Royal Society, according to the *London Times*, a paper on *Iron and Steel at Welding Temperatures* by Mr. T. Wrightson, M. P., was read. The object of the paper was to demonstrate that the phenomenon of welding in iron is identical with that of regelation in ice. The author recapitulated some experiments which were made by him in 1879-80 upon cast iron, and proved the fact that this form of iron possesses the property of expanding while passing from the liquid to the plastic state during a small range of temperature, and then contracts to the solid state, and that the expansion amounts to about 6 per cent. in volume. This property of iron resembles the similar property of water in freezing, which, within a range of about 4° C., expands about 9 per cent. of its liquid volume, and then contracts as the cooling proceeds. Subsequent investigations at the Mint appeared to prove that wrought iron at a welding temperature possesses the same property of cooling under pressure which was proved by Lord Kelvin to exist in freezing water, and on which demonstration the generally received theory of regelation depends. The author distinguished the process of melting together of metals from that of welding. Either process forms a junction, but the latter takes place at a temperature considerably below the melting point. The well-known and useful property of welding in iron appeared,

therefore, to depend, as in the case of regelation in ice, upon this critical condition, which exists over a limited range of temperature between the molten and the plastic state. An interesting discussion followed, in which Lord Kelvin, Professor Roberts-Austen, Professor Silvanus Thompson and others joined.

THE JOINT COMMISSION OF THE SCIENTIFIC SOCIETIES OF WASHINGTON.

At a meeting of the Joint Commission of the Scientific Societies of Washington, on January 25th, recommendations were made which have since been adopted by the Societies represented on the Commission, which are: The Anthropological, the Biological, the Chemical, the Entomological, the Geological, the National Geographic, and the Philosophical Societies.

The resolutions adopted are as follows:

The Joint Commission of the Scientific Societies of Washington, believing that fuller coöperation of the Societies is desirable, and that it can advantageously be provided for by enlarging the powers of the Joint Commission, recommend to the Societies the adoption of the following:

The Joint Commission shall be composed of the officers and administrative boards of the several component Societies

The Commission shall have power:

- a. To provide for joint meetings of the Societies;
- b. To conduct courses of popular lectures;
- c. To prepare a joint directory of the members of the Societies;
- d. To distribute to all members of the Societies periodic advance notices of the meetings of the several Societies;
- e. And to act in the interest of the component Societies at the instance of any of them.

The following officers have been elected: President, Gardiner G. Hubbard; Vice-President, G. Brown Goode; Secretary, J. S. Diller; Treasurer, P. B. Pierce; Members at Large of the Executive Committee, J. W. Powell, William H. Ashmead, George M. Sternberg, G. K. Gilbert, W. H. Dall, Charles E. Munroe and C. D. Walcott.

GENERAL.

THE *Educational Review* for March should be read by all who are interested in elemen-

tary and secondary education. The number consists of the report of 'The Committee of Fifteen' appointed by the Department of Superintendence of the National Educational Association and submitted at Cleveland, February 19-21. The three sub-committees report respectively, 'On the training of teachers,' 'On the correlation of studies in elementary education,' and 'On the organization of city school systems.'

MR. T. C. MARTIN contributes to the March number of *The Century Magazine* an article on Hermann von Helmholtz well calculated to impress the general reader with the magnitude of Helmholtz' genius. The article is accompanied by a portrait of Helmholtz, as he appeared during his visit to America in 1893, which should be preserved by all men of science.

THE American Book Company has just published a fourth edition of Dana's *Manual of Geology*, the work being enlarged by 150 pages. The entire manuscript, extending to 1000 pages of printed matter, is in Professor Dana's own hand-writing, which is remarkable in the case of an author in his eighty-third year.

A TELESCOPE is being constructed for the Berlin Industrial Exposition, to be held next year, in which the lenses, made by Steinheil of Munich, will be 110 cm. in diameter.

HELMHOLTZ' library has been bought by the German Government for the Physico-Technical Institute.

THE annual appropriation for the University of North Carolina has been made by the Legislature. It had been feared that this might not be done. The recent Legislature has reorganized the Board of Regents of the West Virginia University and has reduced it from thirteen to nine, requiring all the members to be appointed from the two leading political parties, as nearly equally divided between them as practi-

cable; its members are appointed for a period of six years, one-third changing every two years. Owing to former dissensions in the faculty of the University, the time of all the professors expires on June 15th; and the Board, at its meeting in June, will elect an entire new faculty, including president and professors. This applies only to the professors of the University, not to members of the Agricultural Station Staff. Dr. Rudolph J. J. de Roode, Chemist of the Station, resigned the first of February, to accept a more lucrative position in New York. His position has been filled by the appointment of B. H. Hite as chemist and G. Wm. Gray as assistant chemist, both of Johns Hopkins University.

SOCIETIES AND ACADEMIES.

THE BIOLOGICAL SOCIETY OF WASHINGTON.

At the meeting held March 9, 1895, the papers were presented, of which abstracts are here given.

Dr. C. W. Styles spoke of *A double-pored Cestode with occasional single pores*.* Great stress has been laid upon the arrangement of the genital pores in the classification of the Cestoda, but this character alone is not of generic value. Stiles has already shown that although *Thysanosoma Giardi* generally possesses alternate genital pores, it occasionally possesses double pores in its segments. In American rabbits, the speaker finds two species of tapeworms, one of which possesses irregularly alternate genital pores and a peculiar arrangement of the eggs in capsules—such as is found in the genus *Darainea*; this makes it possible that this species is the adult stage of the armed cysticercosis described from the intestine of rabbits in his Note 31; if this be so, the parasite would be classified with the genus *Darainea*, although, according to Railliet's

*To be published as 'Notes on Parasites, 36: A double-pored Cestode with occasional single pores' in *Centralblatt für Bact. u. Parasitenkunde*, 1895.

present classification, based upon the arrangements of the pores, it is an *Andrya*. The second tapeworm possesses *double genital pores*. If classified on its pores alone, it is a *Ctenotaenia* Rail. It differs from the type of the genus (*Ct. marmota*) in possessing a double uterus instead of a single uterus. One strobila of this rabbit tapeworm (*Ctenotaenia* sp.?) was found in which most of the segments possessed double pores, but thirteen segments were found with irregularly alternate pores. This anomaly is extremely important, both from a morphological and a systematic standpoint, and the speaker expressed the opinion that a thorough study of a large series of Cestoda in any group would result in greatly modifying the present classification and in suppressing a large number of species.

Dr. Theo. Holm discussed *Oedema of Violet Leaves*. Leaves of a cultivated garden variety of *Viola odorata* affected with this disease were studied, and their anatomical structure showed several points of interest. The diseased parts of the leaf showed brownish, wart-like swellings on both faces of the blade, above and between the nerves. The following changes were observed in the tissues: The epidermis became very thick-walled, and the stomata modified into narrow, irregular openings. The palisade tissue showed numerous (three or even four) tangential divisions, and swelled up very considerably, pushing out through the epidermis. The pneumatic tissue, which seemed to be the most affected, had increased in size, the cells having divided themselves very considerably so as to form a loose, open tissue of large, roundish cells. The petiole showed similar symptoms of the disease, especially along the keel and the wings. The collenchymatic tissue underneath the epidermis, the bark parenchyma, and the endodermis showed numerous divisions, so that similar swellings were produced like those observed on the leaf blade.

Dr. Geo. M. Sternberg read a paper entitled *Explanation of Acquired Immunity from Infectious Diseases*, an account of which will be printed in the next issue of SCIENCE.

M. B. WAITE,
Recording Secretary.

SCIENTIFIC JOURNALS.

THE JOURNAL OF MORPHOLOGY.

THE latest number of the *Journal of Morphology* is of exceptional importance. Mr. Frank Lillie's article upon the *Embryology of the Unionidae* contains a most careful investigation of the relations of the earliest cells in the embryonic cleavage to the adult organs of the body. This is followed by Oliver S. Strong's memoir upon the *Cranial Nerves of the Amphibia*, which opens up a new and thoroughly philosophical interpretation of the cranial nerves, based not upon their numerical relations, but upon their physiological components. This is the result of an investigation of a very difficult character which has been under way for the past five years. The third paper, by Pierre A. Fish, upon the *Adult Nervous System of the Salamander*, is followed by a brief but interesting paper from Professor W. K. Brooks upon the *Sensory Clubs of Certain Coelenterates*.

The most important feature of this number, however, is contained in three short preliminary papers at the end of the *Journal*, occupying only a few pages, but apparently establishing a new law in the field of fertilization phenomena. The discovery has been made independently by Dr. Wheeler and by Dr. A. D. Mead, of the University of Chicago, and by Professor E. B. Wilson and Mr. A. T. Matthews, of Columbia College. In course of correspondence the authors of these papers learned that they had independently reached the same unexpected conclusion, and it was arranged by the editor that their three communications should appear together. While they mark an important step forward in our knowledge of

fertilization, at first sight the results obtained by Dr. Wheeler and Professor Wilson are directly contradictory. Dr. Wheeler proves conclusively that in the fertilization of *Myzostoma* (a parasitic form of Annelid) there are no traces of the archoplasm or dynamic substance in the spermatozoon, and that this element is entirely resident in the ovum. Professor Wilson, on the other hand, independently working on the eggs of the echinoderm *Toxopneustes*, proves that there is no trace of the archoplasm in the ovum, but that it is entirely resident in the spermatozoon. It is too soon to make a general induction from these observations, but at present they appear to wholly set aside the brilliant announcement of Fol in 1891, which has been supported by Guignard and Conklin, that both the ovum and spermatozoon contain archoplasm, and that one feature of segmentation is a 'quadrille of the four centers' derived from these male and female archoplasmic masses. These observations do prove, however, that the archoplasm may be derived exclusively either from one sex or the other, and they show that Fol's law was based upon defective preparations. They tend also to show that the archoplasm is not a bearer of the hereditary qualities, but necessarily a purely neutral dynamic agent.

THE PSYCHOLOGICAL REVIEW, MARCH.

THE current number is largely taken up with the Princeton meeting of the *American Psychological Association*, already reported in SCIENCE (January 11). Authors' abstracts are given of sixteen papers presented, and the address of the President, Prof. William James, is given in full. Mrs. Franklin's paper on *Normal Defect of Vision in the Fovea* was also read before the Association. The only remaining paper consists of Contributions from the Psychological Laboratory of Columbia College. Dr. Griffing describes experiments on the relations between der-

mal stimuli and sensations, and Mr. Franz gives an account of measurements of the light which is just sufficient to produce an after-image. In addition to discussion and notes, there is an extended survey of recent psychological literature prepared by Profs. Sully, Ormond, Fullerton, Dewey, Baldwin, Donaldson, Cattell, Angell, Gardiner and Duncan, and Drs. Binet, Kirschmann, Tracy and Noyes.

THE POPULAR SCIENCE MONTHLY, MARCH.

THE number opens with an interesting account of *The Birth of a Sicilian Volcano* by Prof. Packard, describing an ascent of Monte Gernellaro, a crater on Mount Etna formed in 1886. In the second paper Dr. Bela Hubbard dwells on the importance of the forests and the need of legislation to prevent destruction by fire. An article by Dr. S. Millington Miller discusses the education of the blind and of the deaf and dumb and their careers. The number includes articles on engraving and bookbinding, two articles on scientific education, and accounts of Tyndall's work and of Thomas Nuttall (with a portrait).

THE ASTROPHYSICAL JOURNAL, MARCH.

Notes on the Atmospheric Bands in the Spectrum of Mars: WILLIAM HUGGINS.

Recent Researches on the Spectra of the Planets: H. C. VOGEL.

Solar Observations made at the Royal Observatory of the Roman College in 1894: P. TACCHINI.

On a very large Protuberance Observed December 24, 1894: J. FÉNYI.

On the Distribution of the Stars and the Distance of the Milky-Way in Aquila and Cygnus: C. EASTON.

Preliminary Table of Solar Spectrum Wave-Lengths. III.: H. A. ROWLAND.

The Modern Spectroscope: F. L. O. WADSWORTH.

Minor Contributions and Notes; Reviews; Recent Publications.

BULLETIN OF THE AMERICAN MATHEMATICAL SOCIETY, FEB.

On a Certain Class of Canonical Forms: RALPH A. ROBERTS.

Hayward's Vector Algebra: MAXIME BÔCHER.

Apolar Triangles on a Conic: F. MORLEY.

An Instance Where a Well-known Test to Prove the Simplicity of a Simple Group is Insufficient: GEORGE S. MILLER.

Briefer Notices; Notes; New Publications.

THE AMERICAN GEOLOGIST, MARCH.

Development of the Corallum in Favosites forbesi, var. occidentalis: GEORGE H. Girty.

Early Protozoa: G. F. MATTHEW.

The Stratigraphic Base of the Taconic or Lower Cambrian: N. H. WINCHELL.

The Second Lake Algonquin: F. B. TAYLOR.

Editorial Comment; Review of Recent Geological Literature; Correspondence; Personal and Scientific News.

NEW BOOKS.

Guide to the Study of Common Plants. VOLNEY M. SPALDING. Boston, D. C. Heath & Co. 1895. vii + 294.

Government of the Colony of South Carolina. EDSON L. WHITNEY. Baltimore, The Johns Hopkins University Press. 1895. Pp. 121. 75 cents.

Theoretical Chemistry. W. NERNST. Translated by Charles Steele Palmer. London and New York, Macmillan & Co. 1895. Pp. xxv + 697. \$5.

Mechanics. Dynamics. R. S. GLAZE BROOK. Cambridge University Press. New York, Macmillan & Co. 1895. Pp. xii + 251. \$1.25.

Diary of a journey through Mongolia and Tibet. WILLIAM WOODVILLE ROCKHILL. Washington, Smithsonian Institution. 1894. Pp. xx + 413.

Noxious and Beneficial Insects of the State of Illinois. S. A. FORBES. Springfield, Ill. 1894. Pp. xi + 165 + xii.